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In re Application of: Lior BAUSSI
Serial No.: 10/516,926
Filed: July 14, 2005
Office Action Mailing Date: October 5, 2006

Examiner: Marcos L. Torres
Group Art Unit: 2617
Attorney Docket: 37160
(prev.: 340/04299)

REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 1-23 and 25-49 are in this Application. Claims 4-10, 21, 22, 30-32, and 39-42 have been rejected under 35 U.S.C. § 112.

Claims 1, 20-26, 39, and 43 have been rejected under 35 U.S.C. § 102.

Claims 2-19, 27-38, 40-42, 44-47 have been rejected under 35 U.S.C. § 103.

Claim 24 has been canceled herewith.

Claims 1, 2, 4-10, 12, 25, 26, 31, 39-44, have been amended herewith.

New claims 48-49 have been added herewith.

35 U.S.C. § 112 Rejections

Claims 4-10, 39 and 42 were rejected for the use of the word "about". This word has been deleted from the claims.

Claim 8 was rejected as unclear because of its dependence on claim 7. Claim 1 is amended to depend on claim 3.

Claim 32 was rejected as being unclear for the use of the term "dither". The Examiner is correct that one interpretation of the term is to "randomize". However, as shown in the enclosed articles, the term "dither" also means a periodic frequency change which can be of any shape. Since the present invention can utilize other than random dithering the term is not amended.

Claims 21 and 22 were rejected as being unclear for the use of the term "DC level". The applicant submits that this term is clear in its context, as shown by the examiner's correct interpretation of the term to mean "ISSR". Therefore, the term is not amended.

Claim 30 was rejected for reciting "each first units". Applicant does not find this term in the claim.

Claim 31 was rejected for not having antecedence for the term "any two of the first units". Claim 31 is currently amended to supply such antecedence. However,

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Applicant holds that the language of the claim before amendment was clear also before the amendment, and that the amendment merely puts explicitly what was clear implicitly from the original claim.

35 U.S.C. § 102 Rejections

Claims 1, 20-26, and 39 were rejected as being anticipated by Desh, US6,078,260. Applicant amended the claim to recite that "the at least one first and at least one second unit comprise non-telephony circuitry that enable the first and second units to exchange data over a non-telephony channel responsive to the display generated by the controller, which data enables communication with the given first unit via conventional cell phone telephony". Applicant submits that Desh does not anticipate a direction finding system as currently claimed in claim 1.

Rejected claims 20-26 and 39 depend on claim 1, and are patentable over Desh at least for the same reason that claim 1 is.

Claim 43 was rejected as being anticipated by Katsuno, US 7,085,577. Applicant amended the claim to recite that "the transceiver of the second phone of the plurality of phones that receives an interrogation signal, transmits a signal comprising data that enables the first phone to establish conventional cell phone communication with the second phone". Applicant submits that Katsuno does not anticipate a communication system as currently claimed in claim 43.

35 U.S.C. § 103 Rejections

The rejections under Section 103 rely on Desch or Katsuno, in combination with Donath, Jelloul, Tachikawa, and/or Brodie. The Applicant submits that none of these references, alone or in combination with any of the other cited reference, teaches or even hints to a system as currently claimed.

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In view of the above amendments and remarks it is respectfully submitted that claims 1-23 and 25-49 are now in condition for allowance. A prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,

Paul Fenster
Paul Fenster
Registration No. 33,877

Date: April 4, 2007

Encl.:

Petition for Extension of Time (3 Months)
Additional Claims Fee
References by:
MAXIM Dallas Semiconductors 2003
Steve Hageman 2005



Maxim/Dallas > App Notes > MICROCONTROLLERS

Keywords: spread spectrum, oscillator, DS1086, DS1086L, FCC, EMC, EMI, electromagnetic compatibility

Nov 21, 2003

APPLICATION NOTE 2863

The Effects of Adjusting the DS1086L's Dither Span and Dither Frequency on EMC Measurements

The DS1086L is a 3.3V spread spectrum oscillator that is used in applications concerned with complying with electromagnetic compatibility (EMC) standards such as FCC part 15 or CISPR 22. Ideally with this architecture the peak power attenuation is always proportional too the dither span and the ratio of the output frequency to the dither frequency. This application note discusses the practical limits for these parameters incurred due to the way power spectrums are measured.

Introduction

The DS1086L is a 3.3V spread-spectrum oscillator that is used in applications concerned about complying with electromagnetic compatibility (EMC) standards such as FCC part 15 or CISPR 22. The output of the DS1086L is a 50% duty cycle square wave that is frequency modulated by a triangle wave to produce a flat wide-band spectrum with lower peak power levels.

Ideally with this architecture the peak power attenuation is always proportional too the dither span and the ratio of the output frequency to the dither frequency. This application note discusses the practical limits for these parameters incurred due to the way power spectrums are measured.

Dither Span and Frequency in the Power Spectrum

Modulating a square wave's frequency with a triangle wave creates a bandwidth composed of individual spectral lines about the fundamental frequency. The modulation frequency (f_D) determines the spacing of the spectral lines (see Figure 1b), and the dither span (D%) determines the bandwidth of the signal about the fundamental frequency. Figure 1 shows all the additional spectral lines below the original output frequency, which is consistent with the downmodulation scheme of the DS1086L.

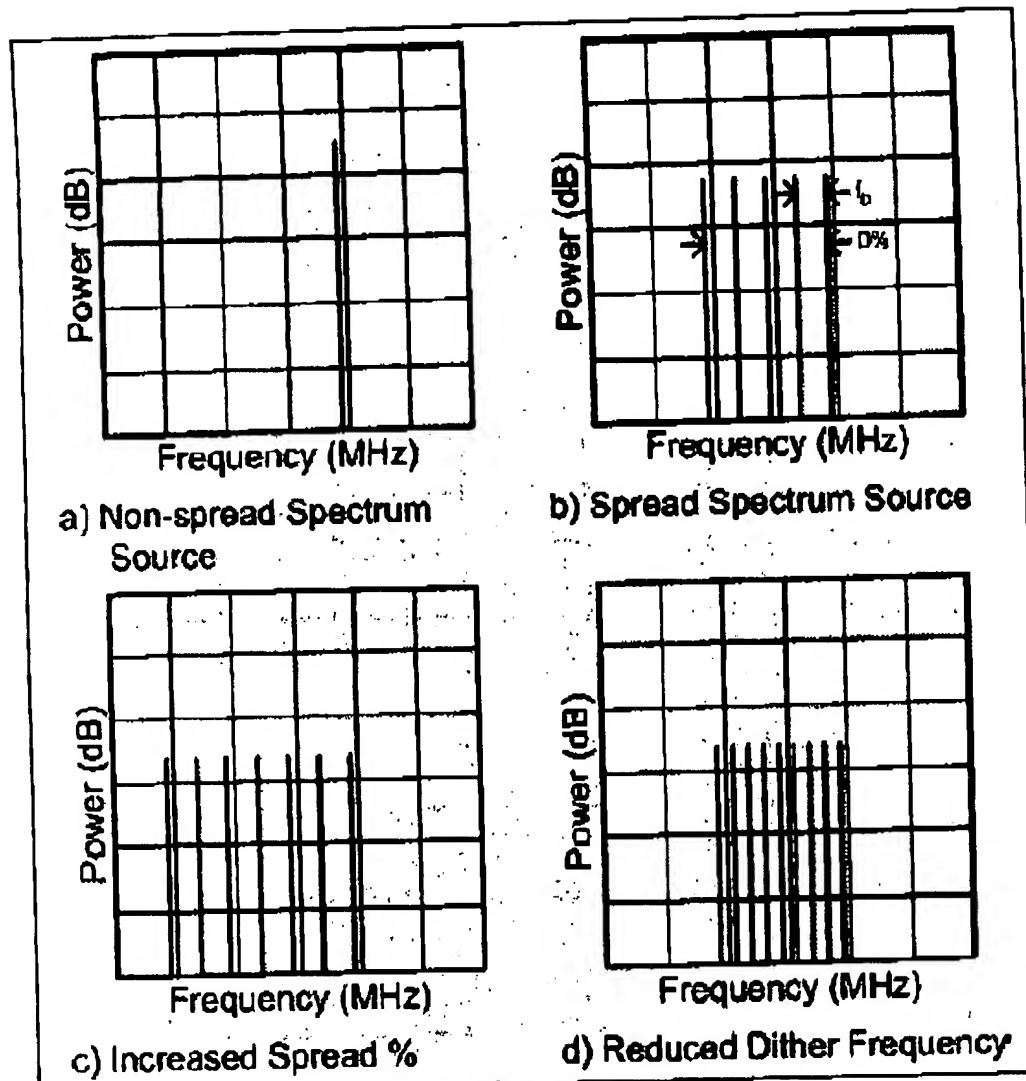


Figure 1. Spectral components of non-dithered and dithered oscillators.

The peak power attenuation seen in the power spectrum of a dithered oscillator is derived from the fact that both the dithered and undithered oscillators deliver the same amount of power into a given load. An undithered oscillator (Figure 1a) delivers all the signal power at one frequency. The dithered signal's (Figure 1b) power is delivered via multiple spectral lines with a lower power level for each individual spectral line. Both increasing the dither percentage (Figure 1c) and reducing the dither frequency (Figure 1d) increase the number of spectral lines, which reduces the power of any one spectral line.

A formula for calculating the expected peak power attenuation versus a narrow band source is given by:

$$\text{Peak Attenuation (dB)} = 10 \log_{10} \left(\frac{D\% \cdot f_o}{f_D} \right)$$

D% is the dither span (e.g. 4%=0.04)

f_o is the output frequency

f_D is the dither frequency

This formula is only accurate when the dither frequency is high enough that there is only one spectral line per measurement bandwidth. This phenomenon is described below and illustrated by Figure 2.

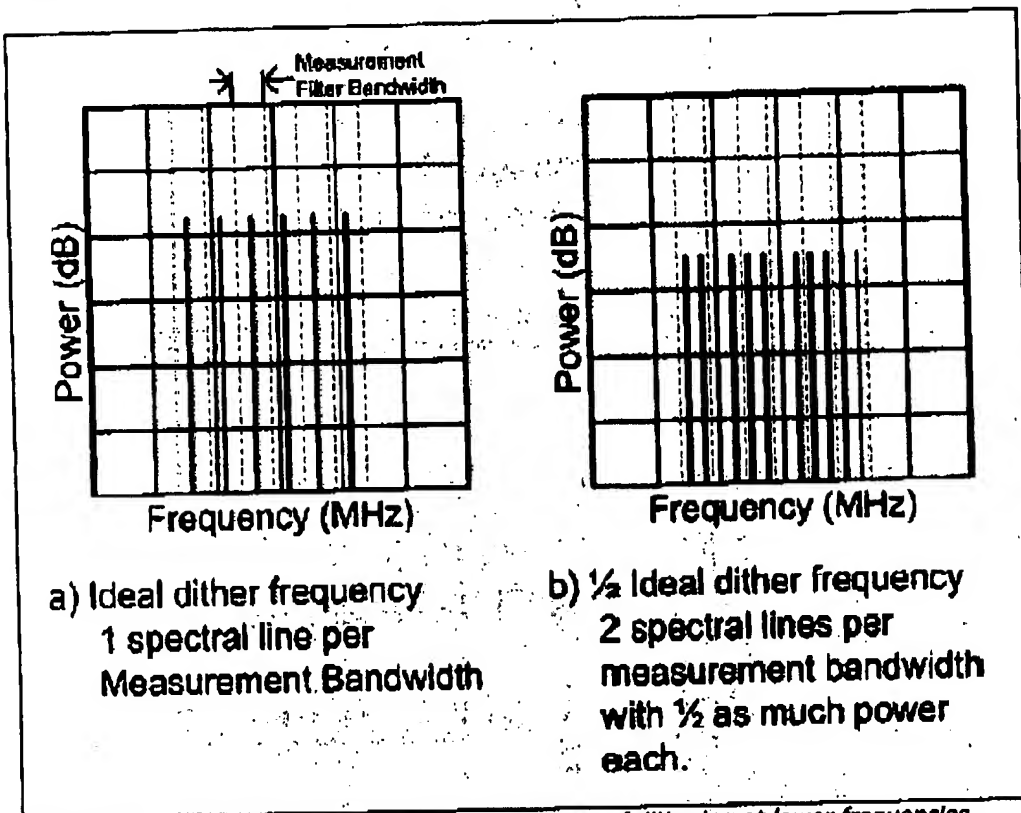


Figure 2. The Ideal dither frequency and the effects of dithering at lower frequencies.

The Effects of Measurement Bandwidth

The resolution bandwidth is the bandwidth of the filter used for a single measurement point that is displayed on the screen of a spectrum analyzer. It is generally a bandpass filter after the mixer on an analyzer, and it is used to select the range of frequencies that will be presented to the detector. Selecting a narrower bandwidth improves the analyzer's ability to discern neighboring frequencies.

The resolution bandwidth used during measurements on spread-spectrum oscillators has a profound effect on the levels measured for two reasons. The first reason is the resolution bandwidth used for a measurement determines what is narrow-band and what is a wide-band signal. If a signal that has a 100Hz bandwidth and its frequency is within the range of a 1kHz bandpass filter, the analyzer can easily detect the power level of the entire signal by taking one measurement. This makes the 100Hz signal narrow band with respect to the

analyzer's current settings. If the signal's bandwidth becomes 10kHz while retaining the same power level, the analyzer will read only a portion of the power per measurement because the entire signal cannot be measured within one resolution bandwidth. Thus, the DS1086L dither percentage should be set high enough that the signal being measured is wider than the resolution bandwidth or no EMI improvement will be measured because the signal is perceived as narrow band. The EMI will be attenuated versus the non-dithered signal, but it will not measure as such, which is important when trying to comply with EMC standards.

The second relationship between the resolution bandwidth and the dither is that the dither frequency must be greater than the resolution bandwidth if lowering the dither frequency is expected to increase the attenuation. This condition is true because when multiple spectral lines exist within one measurement bandwidth, the power from all the spectral lines within the measurement bandwidth will add to produce the same power as one spectral line within the bandwidth (Figure 2). Thus once the dither frequency is below the resolution bandwidth, there is no longer any attenuation benefit to be gained by further reducing the dither frequency as identified by the attenuation formula. It should be noted that this statement is not intended to imply that the dither frequency should not be lower than the resolution bandwidth.

Often, the measurement bandwidths of concern are those required to meet the FCC part 15 class B standard. Part 15 requires that frequencies below 30MHz are detected with a 9kHz measurement bandwidth and frequencies between 30MHz and 1GHz are measured using a 120kHz measurement bandwidth. The dither frequency of the DS1086L is between 4.1kHz and 32.5kHz depending on the dither rate setting and the master oscillator frequency. For measurements above 30MHz, there are always multiple spectral lines per measurement, so there is no obvious benefit to using any particular dither frequency setting. The lower dither frequency settings still have a non obvious benefit that they reduce the slight peaks caused by internal bandwidth limitations that can be seen at the edges of the spread-spectrum bandwidth. For frequencies below 30MHz, the lowering the dither frequency provides more attenuation until the dither frequency is below the 9kHz measurement bandwidth.

The Effect of Spread-Spectrum Oscillators on Harmonics Measurements

A sine wave appears in the frequency domain as a single spectral line (delta function) with an amplitude equal to the power of the signal. A square wave with the same frequency has a fundamental frequency component that appears at the same frequency as the corresponding sin wave, but the amplitude is only 64% of the square wave's power. The remainder of the power is spread out at the odd harmonics with a $1/n$ amplitude roll off, where n is the n^{th} odd harmonic.

Spread-spectrum oscillators can see an additional benefit related to measured harmonic content. The bandwidth of the odd harmonics of a frequency modulated square wave is equal to harmonic number times the bandwidth of the square wave at the fundamental frequency (see Figure 3). The wider bandwidth is a result of the separation of the spectral lines, which reduces the number of spectral lines per measurement bandwidth. This phenomenon is particularly important when examining the oscillator using the 120kHz FCC measurement bandwidth. As mentioned before, there are always multiple spectral lines with the DS1086L near the fundamental frequency when using the 120kHz measurement bandwidth, but as the spectral lines separate at the harmonics, the peak power is reduced beyond the $1/n$ reduction. The harmonic roll off is approximately $1/n^{3/2}$ until the spectral lines separate far enough that there is only one spectral line per measurement bandwidth.

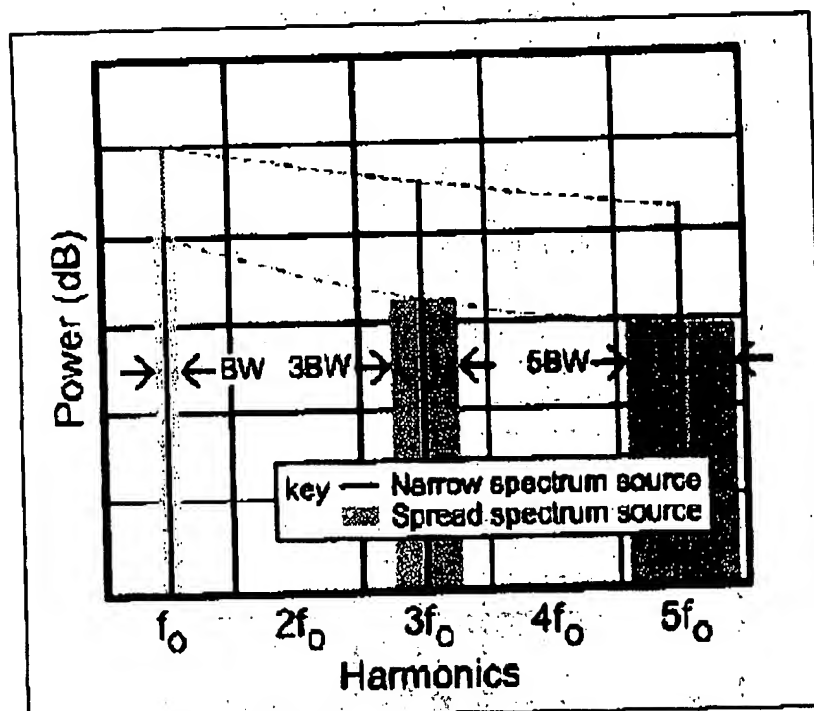


Figure 3. Spectral content for dithered oscillator harmonics.

The reason that a non-dithered signal, such as a low jitter crystal oscillator, does not benefit from the widening bandwidth phenomenon is that the bandwidth is much narrower than the measurement bandwidth to begin with. When looking at the 3rd or 5th harmonic, the 3x or 5x signal bandwidth is still narrow band compared to the 120kHz measurement bandwidth so all the energy is still being detected within one measurement.

Conclusions

The DS1086L is a spread-spectrum oscillator that features the ability to change both the dither span and the dither frequency. Changes to the dither span and frequency can be used to optimize the measured EMI performance at both the fundamental frequency and its harmonics. To constructively change these parameters, the effects of the EMI measurement bandwidths must be understood in addition to the application's timing needs.

Application Note 2863: <http://www.maxim-ic.com/an2863>

More Information

For technical questions and support: <http://www.maxim-ic.com/support>

For samples: <http://www.maxim-ic.com/samples>

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Related Parts

DS1086: [QuickView](#) -- [Full \(PDF\) Data Sheet](#) -- [Free Samples](#)

DS1086L: [QuickView](#) -- [Full \(PDF\) Data Sheet](#) -- [Free Samples](#)

DS1087L: [QuickView](#) -- [Full \(PDF\) Data Sheet](#) -- [Free Samples](#)

AN2863, AN 2863, APP2863, Appnote2863, Appnote 2863

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Frequency dithering enhances high-performance ADCs

Steve Hageman, Windsor, CA

Since the late 1970s, designers have successfully improved the effective resolution and spurious performance of A/D converters by adding dither—uncorrelated noise—to a converter's input and then using DSP techniques to average out noise from the converted data. The most common dithering method adds random-amplitude noise to an A/D converter's input signal. Although this method works, the added noise includes large random peak values. To keep the A/D converter's input out of the saturation region, a designer must know both the peak signal and the peak dither levels. Even briefly saturating the A/D converter adds more nonlinearities than dither can remove.

Another approach adds a dithered-frequency, constant-amplitude signal. Figure 1 shows one possible implementation featuring a Linear LTC1799 programmable oscillator, IC₂, that's operated in a VCO (voltage-controlled-oscillator) mode in which an applied voltage modulates the center frequency. You can set the LTC1799's center frequency at 1 kHz to 33 MHz, making it a suitable dither generator for many currently available A/D converters. Because the LTC1799's output comprises a square wave, its peak output amplitude is well-defined.

You can set the random-dither center frequency either below or above the signal frequency of interest. For conversion of a narrowband intermediate

frequency, either location may work well. For an A/D converter that must operate to dc, the only useful location is above the signal frequency of interest. One approach places the dither frequency at one-half of the sampling or the Nyquist frequency. When you place it there, the random noise typically doesn't interfere with the desired signal, and any aliasing that occurs only folds the random frequency noise around itself and not into the desired signal band.

The circuit in Figure 1 operates with a 20-MHz sampling A/D converter and generates random noise around a center frequency of 10 MHz. You can use any of a number of techniques to generate the random noise, including dig-

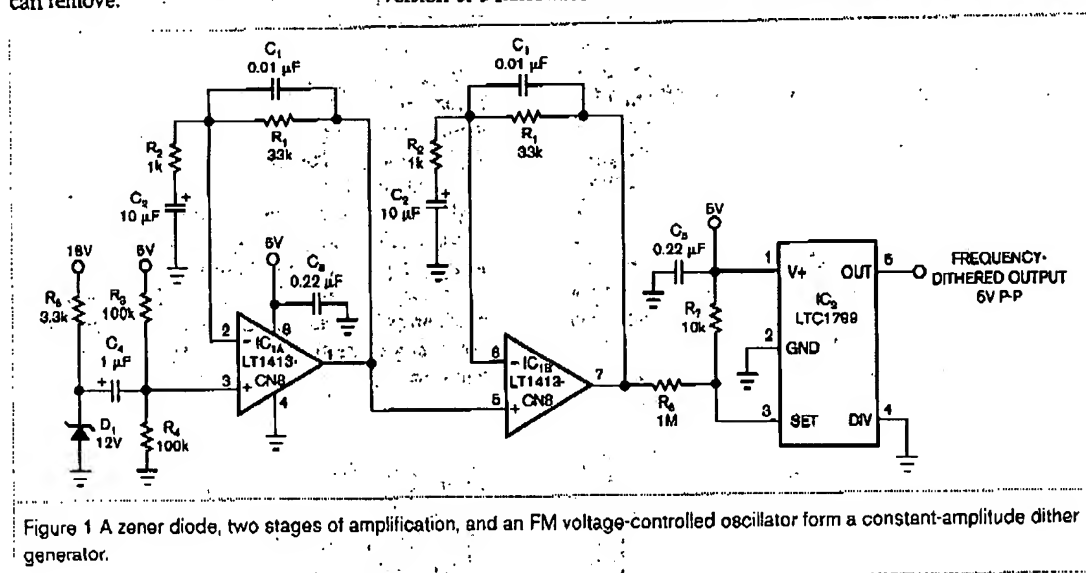


Figure 1 A zener diode, two stages of amplification, and an FM voltage-controlled oscillator form a constant-amplitude dither generator.

designideas

ital shift registers and semiconductor junctions biased into the breakdown range. In this design, a 12V zener diode, D_1 , generates the noise, which a two-stage amplifier amplifies and frequency-shapes. If necessary, you can further shape the noise distribution by using more complex active-filter sections, IC_{1A} and IC_{1B} . After filtering, the noise modulates the LTC1799. Make sure that the LTC1799's power-supply voltage is pure dc and free of ripple, because power-supply noise produces nonrandom AM sidebands.

Figure 2 shows an amplitude-versus-frequency plot of the frequency-limited spectrum that the design in Figure 1 produces. Depending on the circuit's configuration, you can apply the dither to the A/D converter using a small coupling capacitor or a more complex active summing circuit. Although zener-diode noise generators offer theoretical simplicity, they behave poorly in production environments because

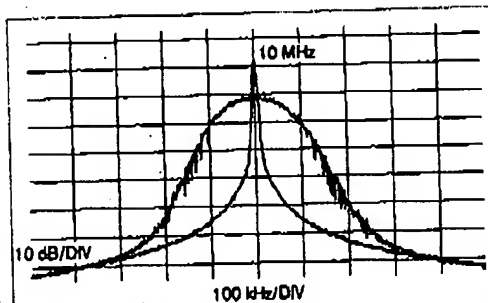


Figure 2 The broad bell-shaped curve shows a random-frequency-dithered spectrum superimposed onto the LTC1799's unmodulated, 10-MHz output.

their noise outputs can vary greatly. Even among diodes from the same manufacturing batch, you can observe popcorn noise, unevenly distributed noise histograms, amplitude shifts, and frequency-weighted noise. In a high-volume application, well-specified noise diodes, such as those from Micronetics (www.micronetics.com), may prove more cost-effective than zener diodes.

Once you select a noise diode, you

can select amplification-stage gains such that clipping of noise peaks isn't evident at the circuit's output. If your application requires it, you can alter the amplifiers' frequency responses to alter the noise spectrum. Finally, adjust the LTC1799's frequency-setting resistors, R_6 and R_7 , so that the noise-spectrum display resembles that in Figure 2. Any clipping along the amplifier path tends to add peaks to the edges of the spectrum, which indicates amplitude clipping and

reduction of the noise's random characteristics.

You can add a filter between the noise output and the A/D converter's summing input to limit inband noise or remove any periodic modulation that power-supply ripple introduces. In a modern, high-performance A/D converter, even a small amount of periodic noise can manifest itself as a -80 -dBc (decibels-below-carrier) spurious response. **EDM**